THE IMMUNE SYSTEM
Presentation and Activities
L3: The Cells of The Immune System

**BIG QUESTION:** What cells are responsible for helping the immune system fight infection?

**Lesson Objectives: SWBAT**
- Describe the cells that make up the immune system
- Describe cells and organisms which can attack the immune system
- Compare the functions of different white blood cells
L3: The Cells of The Immune System

The immune system consists of tissue and organs, however it could be argued that the real heroes are the cells. The white blood cells, sometimes called Leucocytes are the front line, the soldiers on the ground that fight the never ending battle against disease and infection.

I NEED YOU FIGHTING FIT!
GIVE ME 20!

Private White Blood Cell
There are two main types of cells that fight infection. These are **PHAGOCYTES** and **LYMPHOCYTES**.

All White blood cells start out in the bone marrow, they then migrate to different parts of the body where they mature and specialize.
The Lymphocytes are white blood cells which include: T-Cells, B-Cells and Natural Killer Cells.
T-CELLS

There are many different types of T-Cells, each with a specific function.

- **CD4 and Th Cells (T Helper Cells):** these cells activate and regulate T and B Cells.

- **CD8 and Cytotoxic T Cells:** these cells target cells that are infected with a virus or cells that are cancerous (tumor cells).

- **Gamma Delta T Cells (γδ T cells):** link the innate (non-specific immune response) with the adaptive (Specific immune response).

- **Regulatory T cells (Suppressor Cells):** regulate the immune system and if necessary suppress it. These cells will come into action after an infection to ensure the immune system returns to normal. They can put an end to an attack, which is important as it can prevent autoimmunity, where the immune system can start to attack their own cells.
B-Cells can be identified because they have surface proteins which act as receptors.

These receptors can bind to specific antigens (something that causes an immune response, such as foreign cells), they then produce antibodies which can tag a cell as being foreign, resulting in that cell being destroyed by the body’s immune system.
**ANTIGENS Vs ANTIBODIES**: What is the difference?

**ANTIGEN**: is something foreign or toxic to the body that will trigger an immune response.

Antigens come in all shapes and sizes, they are usually located on the surface of a microorganism.

They cause B-Cells to generate ANTIBODIES.

**ANTIBODY**: this is a large Y shaped protein that is made by B-Cells to identify and tag antigens.

If an antigen (foreign particle) is tagged by an antibody it will be destroyed by T-Cells and NK Cells.
L3: The Cells of The Immune System

**ANTIGENS Vs ANTIBODIES**: What is the difference?

The **ANTIBODIES** are free forms of the B-CELLS surface receptors.

Once the foreign particle is tagged as an antigen it will be destroyed by the body’s immune system.
NK Cells, known as Natural Killer Cells, target virus infections and tumors. They usually take 3 days to become active. When active they will destroy the infected cells.
The Phagocytes are white blood cells that can **engulf and devour (eat) foreign particles**. There are 3 main types of phagocytes; Neutrophils, Monocytes and Eosinophils.
MONOCYTES: circulate in the blood. They can mature into macrophages in tissue, the macrophages can break down old cells, they also attract lymphocytes, such as T-Cells by presenting foreign antigens to them.
EOSINOPHILS are less abundant in the body they fight multicellular parasites and other infections.
The white blood cells are fighting a constant battle.

Now let's look at what they are up against.

I need you in the briefing room in 2 minutes

Private White Blood Cell
What cells Attack the Immune System?
The cells and foreign particles that attack the immune system consist of **bacteria, fungi, virus, protozoa** and parasites.

I need you in the briefing room in 2 minutes
Warning...

Some of the next several slides contain images of a more graphic nature. If you in any way feel queasy, start sweating, feel lightheaded, or just not quite right please tell me immediately and sit down on the floor.

Remember:
You get only one body. Take care of it. Be protective of it. The information I’m going to share with you is just a little bit of what’s out there.
They are microscopic prokaryotic organisms.

If they enter the body and avoid detection they will reproduce rapidly.

Typical conditions for reproduction and growth include warm temperature, moisture and oxygen, some also need the right pH (acidity or alkalinity) to flourish.

Bacterial infections are treated by using antibiotics, which are usually given in the form of a pill.
Bacteria can cause diseases such as:

- Pneumonia
- Strep Throat
- Syphilis
- Gonorrhea
- E-coli Food Poisoning
- Lyme Disease
- Cholera
Strep Throat...OUCH!!!

Caused by: *Streptococcus* bacteria

**Common Symptoms:** sudden, severe sore throat; high fever over 101° F (38.3° C); swollen tonsils and lymph nodes; white or yellow spots on the back of a bright red throat; headache; belly pain

**Less common symptoms:** a red rash on skin, vomiting, not feeling hungry, and body aches.

**How to Catch Strep:** can be passed from person to person.

Ex: When a person who has strep throat breathes, coughs, or sneezes, tiny droplets with the strep bacteria go into the air. These droplets can be breathed in by other people. If you come into contact with strep, it will take 2 to 5 days before you start to have symptoms.

CAREFUL: You are contagious while you still have symptoms. Most people stop being contagious 24 hours after they start antibiotics. If you don't take antibiotics, you may be contagious for 2 to 3 weeks, even if your symptoms go away.
Thick coating

Swollen tonsil
What is out there we don’t always see or think about?

*Clostridium perfringens*

- Bacteria that can be found as a normal part of decaying vegetation, the human GI tract and other vertebrates, insects, and in soil
- Can cause: food poisoning, gas gangrene, nausea, diarrhea
- In UK and US, third-most-common cause of food-borne illness due to poorly prepared meat and poultry which harbor the bacteria

Blackened area is dead, necrotic tissue.
Fungi are a group of eukaryotic organisms that includes microorganisms such as Yeasts and molds.

They need moist warm places to reproduce. They do not need light, meaning that our body’s make great breeding places.
Fungi, which include Yeasts and molds can cause the following diseases:

- Oral candidiasis, (yeast infection)
- Athletes foot (yeast infection)
Viruses are the smallest of the pathogens.

If they enter the body they invade and hide in cells. This disguises them and often prevents them from being detected by the body’s immune system.

Inside the cell the virus uses the host cell’s machinery and energy to replicate. Once the virus has replicated it explodes the cell, releasing thousands of virus into the body and destroying the host cell.
Viruses, if not destroyed by the immune system, are difficult to treat, as they hide in the body’s cells.

They can’t be treated with antibiotics, and sometimes just need to run their course.

Some Viruses can be treated with antiviral medicines. The **best treatment of viruses is prevention**, via **vaccinations** which will prepare your white blood cells, the B-Cells and T-Cells for future attacks, meaning that they will be able to kill the virus on entry.
Viruses cause many diseases, they include:

- Cold
- Flu
- H1N1 Flu Virus (Swine Flu)
- AIDS
- Measles
- Warts
- Mumps
- Ebola
- Herpes
Thank goodness for the vaccine….small pox has been eradicated!!!

Last case in US – 1949

Last case in the world – 1977 (Somalia)

Highly contagious, can be fatal; caused by *Variola* virus

Symptoms: **HIGH FEVER, WEAKNESS, HEAD AND BODY ACHES, SOMETIMES VOMITING.**

**RASH AND SORES FOLLOW INITIAL SYMPTOMS.**
PARASITES are organisms that live on or in a host. They get their food from the host, and can consequently sometimes make the host sick.

The treatment for parasites is to remove them from the body.
Parasites include:

- Many Protozoa
- Tape Worms
- Flukes
- Ticks
- Fleas
- Head Lice
Protozoa are **unicellular eukaryotic organisms** some of which are **PARASITES**.

Protozoa reproduce in a variety of ways with varying conditions.

Due to the variety of protozoa there are **varying treatments**, some however can’t be treated resulting in death.
Protozoa cause many diseases such as:

- Sleeping Sickness
- Malaria
- Giardiasis (Beaver Fever, not to be confused with Beiber Fever)
Amoeba... the “bad blobs”...

- Amoeba enters nose and gets to the internal nares
- Finds its way to the olfactory nerve following the nerve into the brain
- secretes enzymes and proteins that dissolve brain cells so it can suck up the debris with its food cup (mouth shaped structure).
- **Quick process**... victims usually die seven to 10 days after infection.
- **Initial symptoms**: headache, fever, nausea, vomiting, and stiff neck.
- **Later symptoms**: confusion, inability to pay attention to people and surroundings, loss of balance, seizures, and hallucinations.
- **Death** follows the first symptoms by three to seven days.
- Unfortunately, most victims aren't treated in time (though there are reports of some people surviving with the immediate treatment of very powerful antibiotics).
Amoeba... the “bad blobs”...
N. Fowleri

Isn’t it cute???? 😊
Pinworms...what do they do?

- Pinworms are passed from human to human. Think before you touch.
- More than 40 million cases in the United States each year
- Frequently in school children between 5 to 10 years of age
- What happens... parasites awaken you in the middle of the night by an intense itching around the anus. If you've experienced this you've may have been infected by pinworms for 2-3 months. Pinworms will sneak out at night to lay their eggs on the fertile skin around your anus and then go back inside the anus during the day.
- To confirm a pinworm infestation use a flashlight to inspect a stool sample. Pinworms will show up as "glowing" and about 1/3″ long.
- Another method for detection is a piece of tape. Press the tape to the skin surrounding the anus and remove and examine it for eggs or worms at night.
- Extremely contagious and will contaminate family members, bed sheets, clothing, carpet, and under your fingernails. Ensure fingernails are kept short and avoid scratching the anus. Take a shower at least once per day and change clothes and bed linens daily as well.
The not so friendly pinworm...
Typical site within the large intestine for Pinworm infestation. Pinworms also routinely exit the body via the anus.

Adult organisms congregate within the host and reproduce in large numbers.

Pinworms exit the anus at night to lay their eggs. The host scratches the area and transmits them to mouth if hands remain soiled.
Another type of worm... **HOOKWORM**

- How they get in... contaminated food or water, more commonly through the skin such as walking barefoot (you won’t feel this usually)
- What could happen...
  - You may have itchiness or redness where the larvae penetrate the skin.
  - If they make it undetected into your system you may have a dry cough, blood-tinged sputum, wheezing, and a low grade fever.
  - If the larvae make it all the way to your intestines they'll begin sucking blood at which point you'll lose your appetite, experience killer diarrhea, and most likely double over in abdominal pain, not to mention anemia (low iron levels in the blood).
Hookworm Infestation
The hookworm...look at that mouth.

This hookworm is eating through the intestine walls...OUCH!!!
Ascariasis – Roundworm Infestation

• most common human infection caused by worms in the world
• not real common in the US, though
• Gotten by ingestion of the eggs via contaminated water supplies, for example
• Symptoms seen with mild infestation include:
  – worms in stool
  – coughing up worms
  – loss of appetite
  – fever
  – wheezing
• More severe infestations can result in more serious signs and symptoms, including:
  – vomiting
  – shortness of breath
  – abdominal distention (swelling of the abdomen)
  – severe stomach or abdominal pain
  – Intestinal, liver, and gall bladder blockages
Ok...if you are squeamish you may not want to look at this or the next slide.
Here you will see a resected bowel. This was removed by the doctor to try to save the patient. Prepare yourself.
Giardia lamblia
ENCOUNTER
INFECTIVE FORM: CYST

MODE OF TRANSMISSION
• fecal-oral route
• direct person to person contact
• ingestion of contaminated food or water
• waterborne outbreaks due to contamination of municipal water supplies
• hiker’s/backpacker’s diarrhea due to ingestion of water from mountain streams contaminated by animals

(c) 2004, Honorine Ward, M.D.
Fun Fact: *Giardiasis* is also known as Beaver Fever
The Lung Fluke...an interesting creature.

1. The egg is in the water.
2. The snail eats the egg.
3. The crab eats the snail.
4. You eat the crab that was not cooked properly or was pickled.
5. The egg hatches inside your digestive tract.
6. The baby lung fluke travels from your digestive tract to your lung.
7. Baby grows up hooked onto you.
What’s more unique...

• The lung fluke lives attached to your lungs, but you don’t feel them.
  – WHY?
    • They produce a natural anesthetic, so you can’t feel them.
    • They can be seen in an X-ray, though.
An encapsulated cyst in the lung...
Here comes the lung fluke...look out. 😊
A little graphic, but very interesting...

*Dracunculus medinensis* (a.k.a. The Fiery Serpent or The Guinea Worm)

http://www.youtube.com/watch?v=Qwk-THcjmlI

A little more information for you:

Guinea worm creates a sore where it wants to exit the body. But they are smart...

The sore burns terribly causing so much pain.

What does the person do...dunk their limb in cool water

Guinea worm is happy now. Why? It can release hundreds of thousands of larvae to infect the water supply and starting the cycle all over again.

Takes many painful weeks to months to remove this worm.

Suppose the worm breaks...uh-oh.

If it breaks apart it is more likely to cause a potentially fatal infection and kill its host.
This is only a small touch on what’s out there.

- Hope you enjoyed the show, learned something new about our immune system, have gained a better appreciation for where you live, and better understand how to take care of yourself as you grow up. 😊
L3: The Cells of The Immune System Activity:

1. What are the 3 types of phagocyte?

2. What are the 3 types of Lymphocyte?

3. All white blood cells are categorized as granulocytes and agranulocytes, which white blood cells are granulocytes?

4. What is the difference between an ANTIGEN and ANTIBODY?

5. Produce a visual to explain how a B-Cell uses antibodies to tag a foreign antigen.

6. There are many organisms and microorganisms that can infect the body, in your opinion which is the most deadly type of organism and why? Use evidence to support your argument. You may want to do some extra research.
L3: The Cells of The Immune System Activity:

1. What are the 3 types of phagocyte? Neutrophils, eosinophil, Monocyte,

2. What are the 3 types of Lymphocyte? B-Cells, T-Cell, NK-Cells

3. All white blood cells are categorized as granulocytes and agranulocytes, which white blood cells are granulocytes? Neutrophils, Eosinophils

4. What is the difference between an ANTIGEN and ANTIBODY? Antigen is something that is foreign to the body and causes an immune response. Antibody is something that is released from a B-Cell to signal to other cells that an antigen is present.

5. Produce a visual to explain how a B-Cell uses antibodies to tag a foreign antigen. Will vary

6. There are many organisms and microorganisms that can infect the body, in your opinion which is the most deadly type of organism and why? Use evidence to support your argument. You may want to do some extra research. Will vary, should show evidence of research